Intervention and societal costs of residential community reintegration for patients with acquired brain injury: a cost-analysis of the Brain Integration Programme

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ORIGINAL REPORT

INTERVENTION AND SOCIETAL COSTS OF RESIDENTIAL COMMUNITY REINTEGRATION FOR PATIENTS WITH ACQUIRED BRAIN INJURY: A COST-ANALYSIS OF THE BRAIN INTEGRATION PROGRAMME

Caroline M. van Heugten, PhD[1], Gert J. Geurtsen, PhD[2], R. Elze Derksen, MSc[2,3], Juan D. Martina, MD[2], Alexander C. H. Geurts, PhD[4] and Silvia M. A. A. Evers, PhD[5]

From the [1]School for Mental Health and Neuroscience and Department of Neuropsychology and Psychopharmacology, Maastricht University, Maastricht, [2]Department for Acquired Brain Injury, Rehabilitation Medical Centre Groot Klimmendaal, Arnhem, [3]Windesheim, University of Applied Sciences, Zwolle, [4]Department of Rehabilitation Medicine, Radboud University Nijmegen Medical Centre, Nijmegen, and [5]School for Public Health and Primary Care (Caphri), Maastricht University, The Netherlands

Objective: **The objective of this study was to examine the intervention costs of a residential community reintegration programme for patients with acquired brain injury and to compare the societal costs before and after treatment.**

Methods: **A cost-analysis was performed identifying costs of healthcare, informal care, and productivity losses. The costs in the year before the Brain Integration Programme (BIP) were compared with the costs in the year after the BIP using the following cost categories: care consumption, caregiver support, productivity losses. Dutch guidelines were used for cost valuation.**

Results: **Thirty-three cases participated (72% response). Mean age was 29.8 years, 59% traumatic brain injury. The BIP costs were €68,400. The informal care and productivity losses reduced significantly after BIP ($p < 0.05$), while healthcare consumption increased significantly ($p < 0.05$). The societal costs per patient were €48,449. After BIP these costs were €39,773; a significant reduction ($p < 0.05$). Assuming a stable situation the break-even point is after 8 years.**

Conclusion: **The reduction in societal costs after the BIP advocates the allocation of resources and, from an economic perspective, favours reimbursement of the BIP costs by healthcare insurance companies. However, this cost-analysis is limited as it does not relate costs to clinical effectiveness.**

Key words: brain injuries; cost-analysis; rehabilitation; residential treatment; outcome.

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Correspondence address: Gert J. Geurtsen, Rehabilitation Centre Groot Klimmendaal, Department for Acquired Brain Injury, PO Box 9044, NL-6800 GG Arnhem, The Netherlands. E-mail: Herendubbel@yahoo.com

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INTRODUCTION

The functional consequences of severe acquired brain injury can have considerable impact on the lives of patients and their families. The direct consequences of brain injury are often accompanied by secondary problems in the area of psychosocial functioning (1). The main rehabilitation goal for these persons is to function as independently as possible in their own home and in society (2). The complexity of psychosocial problems in the long term after severe brain injury requires a specialized comprehensive rehabilitation approach. Such approaches can be divided into neurobehavioural programmes, residential community reintegration programmes, and holistic day-treatment programmes (3). In a recent review, it was shown that these comprehensive rehabilitation programmes appear to be effective in patients with brain injury in the long term in terms of a reduction in psychosocial problems, a higher level of community integration and an increase in employment (4). The evidence is, however, still limited because the methodological quality of the studies is low. The authors concluded that sound evidence of the effectiveness of the different programmes should become available and that the cost-effectiveness should be determined since these programmes are intensive and therefore costly. Insight into costs is necessary, amongst others, to justify the allocation of scarce healthcare resources to these programmes.

Economic evaluation in neurorehabilitation is, however, scarce (5). The few economic evaluation studies examining the cost-effectiveness of rehabilitation programmes for patients with brain injury have provided some interesting preliminary results. For instance, a Step-up programme in which patients with brain injury resided in a transitional living setting during the last weeks of inpatient rehabilitation, appeared to be more cost-effective than the inpatient alternative (6). Wood et al. (7) assessed the clinical effectiveness and cost-effectiveness of post-acute community-based social and behavioural rehabilitation for individuals with severe neurobehavioural deficits. In this study, rehabilitation appeared to be cost-effective. Worthington et al. (8) carried out a clinical and cost-outcome evaluation of a neurobehavioural post-acute rehabilitation programme in the UK. Comprehensive and substantial improvements in the life of individuals with brain injury were found. The initial costs of the programme were offset by savings in the costs of support in the medium and longer term. A more recent study by Faul et al. (9) showed that the use of clinical

treatment guidelines for severe traumatic brain injury resulted in substantial savings in costs and lives (acute care). The majority of cost savings were societal costs. Turner-Stokes (10) investigated the cost-efficiency of longer stay rehabilitation in patients with complex neurological disabilities. The longer stay was offset relatively quickly by long-term savings in the costs of care. And, finally, Homaifar et al. (11) examined outpatient utilization and costs in a group of veterans with traumatic brain injury. They concluded that a wide array of outpatient services was used over time, with a considerable variation in costs. The authors also concluded that further research into economic aspects of care after brain injury is warranted. Moreover, generalized conclusions about the costs of care for persons with brain injury are not possible, since the population as well as the forms of care provided are heterogeneous and therefore not comparable. A common element in such research could be to study the societal costs of brain injury. Additionally, results of economic studies should be used with caution as they apply to another jurisdiction; i.e. results are usually not easily generalized from one jurisdiction to another (12).

The objective of this study was, therefore, to examine the intervention costs of the Brain Integration Programme (BIP) and to compare the costs of patients with acquired brain injury from a societal perspective the year before and the year after a community reintegration programme in the Netherlands. For this specific programme, i.e. the BIP for patients with acquired brain injury and psychosocial problems hampering societal participation often accompanied by behavioural problems, the effects of treatment have been found to be promising (13), which makes examining the economic aspects an interesting next step.

METHODS

Brain Integration Programme

BIP is a residential programme that aims for optimal community reintegration. BIP is offered in a standardized way, consisting of 3 modules: the independent living module, the social-emotional module, and the work module. Patients who are referred for treatment in the BIP are checked for suitability on the basis of a semi-structured interview in which the following inclusion criteria are used: brain injury (traumatic, stroke, tumour, hypoxia, encephalitis), and having problems in social areas, emotional disturbances and community integration (Global Assessment of Functioning score < 65 (14)). Patients are excluded from the programme if they are suitable for other (outpatient) cognitive rehabilitation programmes, if they show severe disruptive behaviour, if there is a complete lack of awareness, if they have very severe memory problems, or if they are addicted to drugs. Further details about the BIP are given in Geurtsen et al. (13).

Cost-analyses

The cost-analysis was performed according to the Dutch manual for costing in healthcare, which is a methodological reference case for performing costing studies in the Netherlands (15, 16). The cost-analysis was performed from a societal perspective for the year before and after the BIP. This implies that all relevant costs related to brain injury were taken into account disregarding who is bearing the costs.

Brain Integration Programme intervention costs

The BIP costs include hospital days, nursing hours and treatment hours. Overhead and other indirect costs induced by other departments supporting the brain injury department (such as human resources, information and communication technology (ICT), planning, outside expertise) are also included in the analysis. For the calculation of the intervention costs micro-costing is applied (17). Micro-costing means that each component of the resource use (e.g. hours of work, use of materials, etc.) is estimated and a unit cost derived for each. For this study, the integral costs of BIP were calculated; this means that we have calculated all the fixed and variable costs, including maintenance and overhead. The cost valuation of the BIP is based on the number of employees, the hours of work per week, the surface in square metres, and the number of days of hospitalization. Costs involving personnel and department-specific materials are calculated using a step-down method (17), this means that the overhead departments (administration, laundry, cleaning, etc.) are allocated in a stepwise fashion to all of the remaining overhead departments and to the final cost centres. On average, personnel time allocated to each intervention is netted out from time and multiplied using the costs per full-time equivalent; for all other costs the most applicable distribution formula was used, for instance, for maintenance, in square metres, and, for food, the cost per number of nursing days.

Costs related to brain injury

Cost identification and measurement. The cost-analysis involved a comparison of costs related to brain injury in the year preceding treatment in the BIP with costs in the year following treatment. The identification of cost categories was based on a literature search, detailed analysis of patient records and interviews with healthcare professionals of the brain injury department. The following cost categories were identified: care consumption (including medication and aids), caregiver support, and productivity losses. Intangible costs were not taken into account. Cost volumes were measured using a cost questionnaire. The cost questionnaire was developed on the basis of interviews with 5 patients, 3 healthcare professionals, and 1 economist. Two questionnaires were developed: 1 for patients and 1 for caregivers. The patient version consisted of 67 questions; the primary caregiver version of 77 questions, as the latter also relate to the cost of informal care. Other informal caregivers answered a questionnaire of 19 questions. The questionnaires were divided into a general part, a part investigating the year preceding BIP and a part investigating the situation in the year following BIP. The questionnaires were sent to the home address of the patient. A reminder was sent after 10 days. In case of non-response a telephone interview was offered. Possible bias due to the retrospective nature of the questionnaires was compensated by asking both patients and caregivers for information and by asking the treating psychologist to perform a random check of the responses of the patients. Patients and caregivers consented to participate.

Cost valuation. Care consumption is valued using revised versions of the Dutch Manual for Costing: Methods and Standard Costs for Economic Evaluations in Health Care (15, 16). This guideline produces standard unit costs for The Netherlands. According to this guideline, caregiver support is valued on the basis of the opportunity cost method. This means that the number of hours the caregiver spent on support of the relative with brain injury is valued by means of the income that could normally have been earned during working hours instead of taking care of the patient. The mean income in the Netherlands was €32,000 per year and the mean yearly working time was set at 1356 h (Statistics Netherlands for the year 2005 in which the data were collected (18). As a result, 1 h of caregiver support was valued with an mean salary of €24 per h.

Productivity losses were valued with the friction cost method (19). The basic idea of the friction cost method is that the amount of production lost due to disease depends on the time-span that organizations need to restore the initial production level. In the friction costs, the costs of production lost are equal to the period that is needed to fulfil the vacancy. The lost days are valued using mean day-wages. All production losses outside the friction period are not valued. During the study the friction period was 22 weeks, which is the time needed to fill a vacant position.

For the valuation of the hours' productivity losses before these 22 weeks, the mean salary was also used (i.e. €24 per h for 2005).

Sample

Patients with acquired brain injury who were treated in the BIP in 2005 were selected for analysis when the time of admission to the programme was shorter than 3 years and the time of discharge was at least 1 year preceding the start of the study. These dates were chosen to optimize response rates and reliability of the data, and resulted in a sample of 46 potential participants.

Sensitivity analysis

A sensitivity analysis was performed to check to what extent the valuing of costs was sensitive to change in certain parameters. This was done by examining the (un)certainty of assumptions and conclusions by varying the costs. This sensitivity analysis was done for: (*i*) valuation of healthcare resources; (*ii*) for the valuation of informal caring time; and (*iii*) for the valuation of productivity losses.

For the cost prices of the care resources we used CTG tariff instead of standardized cost prices. The CTG tariff is a national declaration tariff defined by the National Health Tariff Authority in the Netherlands (NZA; http://www.nza.nl). Furthermore, as there is some discussion about the valuation of informal caring time (20), this item was valued using a proxy-good method (20). The proxy-good method is a straightforward valuation method in which the time spent on informal caring is valued at the shadow price of the closest related market substitute. In our sensitivity analysis the shadow price of €26.30 per h for the year 2005 (16) was used, which is the cost of a professional carer for domestic help. In the literature there is some discussion as to whether productivity should be valued using the friction cost method or the human capital method (21). In the human capital method productivity losses are calculated for the entire period of illness, or from the time of premature death up to the mean retiring age (a mean of 65 years).

Statistical analyses

Differences between the data before and after BIP were tested using paired *t*-tests or Wilcoxon signed-rank tests. Differences were calculated only for complete pairs (i.e. patient and caregiver). For all statistical analyses alpha was set at 0.05.

RESULTS

Response

Forty-six cases could be identified on the basis of the criteria for participation. This means that, in total, 92 questionnaires were sent out: 46 patients and 46 caregivers. A total of 55 questionnaires were returned (60%); 33 cases (72% of the identified cases) could be included in the analyses, of which 7 were involving only the patient ($n = 29$) and 4 only the caregiver ($n = 26$), and in 22 cases both the questionnaires of the patient and the caregiver were included in the analysis. The characteristics of the patients and caregivers are shown in Table I. Most patients were men (62%), and most of these had had a traumatic brain injury (58.6%). The age at injury was low (mean 24.0 (13.0)). Most caregivers were parents of the patients (73.1%).

Cost-analysis

In our analyses we looked separately at the costs of the BIP; furthermore, we compared the societal costs the year before and the year after the BIP treatment.

BIP intervention costs

The costs of the BIP were based on direct costs, indirect (overhead) costs and costs for specific expertise (Table II). The mean number of hospitalization days was 175. The number of treatment days was 125, because treatment was offered during weekdays. Nursing hours were also calculated only during weekdays. The mean number of treatment hours was 385.

Table I. *Patient (*n = *29) and caregiver (*n = *26) characteristics*

Characteristics	
Patients	
Gender: M/F, *n*	18/11
Age at admission to BIP, years, mean (SD) [range]	29.8 (10.3) [18–51]
Age at time of brain injury, years, mean (SD) [range]	24.0 (13.0) [3–49]
Education: low/medium/high, *n*	7/18/4
Time from brain injury to admission to BIP, weeks, (SD) [range]	343.9 (357.2) [26–1632]
Brain injury: *n* (%)	
TBI	17 (58.6)
Stroke	7 (24.1)
Tumour	3 (10.3)
Hypoxia	1 (3.4)
Encephalitis	1 (3.4)
Lowest GCS score TBI patients within 24 h, mean (SD) [range]	7.4 (3.9) [4–14]
Coma duration, days, mean (SD) [range]	11.0 (11.1) [1–38]
Treatment duration, days, mean (SD) [range]	198.3 (77.2) [76–382]
Caregivers	
Gender: M/F, *n*	7/19
Age at admission of patient to BIP, years, mean (SD) [range]	51.6 (10.6) [28–78]
Education: low/medium/high, *n*	1/19/6
Relation to patient: *n* (%)	
Parent	19 (73.1)
Spouse	4 (15.4)
Sibling	1 (3.8)
Other	2 (7.6)

TB: traumatic brain injury; GCS: Glasgow Coma Scale; M: male; F: female; SD: standard deviation; BIP: Brain Integration Programme.

Table II. *Brain Integration Programme intervention costs*

Full costs	Hospital stay	Guidance/supervision	Nursing hours	Treatment hours	Total
Cost price (€)	50	61	22	114	–
Treatment profile, mean	175 days	175 days	125 days	385 hours	–
Total (€)	8,750	10,675	2,750	43,890	66,065
Total + risk-premium (3.5%) (€)	9,056	11,049	2,846	45,426	68,400

The total costs of the programme per patient were €68,400, of which €45,426 was spent on treatment.

Costs related to brain injury

Healthcare costs were separated into visits to the general practitioner, consulting a specialist, outpatient services, and inpatient and outpatient care. An overview of these costs the year before and the year after the BIP is shown in Table III. The number of hours of outpatient services that the patients received per year increased significantly, whereas all other costs decreased (not significantly).

Before the BIP 48.5% of the patients used medication. After the BIP this increased to 57.6%. The percentage of patients using memory aids was equal before and after the programme (6.1%) but the kind of aids differed: before the BI patients mostly used laptops and phones, whereas after BIP patients mostly used personal digital assistants, which were estimated to be more expensive at that moment. The use of mobility aids reduced slightly after the BIP, from 21.2% to 15.2%. Home adaptations were more frequent after the BIP: 6.1% before the BIP compared with 8.4% after the BIP.

The total number of hours of informal care given before the programme was 1030, and after the programme 530; this was a significant reduction of 500 h ($p < 0.05$). The hours were spent on direct care, mobility support and financial, administrative and organizational tasks.

Before attending the BIP the patients worked a mean of 187 h per year (3.6 h per week), while after the programme this had increased to 312 hours (6 h per week). Before the BIP 81.3% of the patients were not working, whereas after the BIP this percentage was reduced to 59.4%. From these results the productivity losses are calculated while taking into account a friction period of 22 weeks: the productivity losses reduced by €1363 per friction period.

The living situation of the patients changed significantly after attending the BIP ($p < 0.05$): after the programme 66.7% of the patients lived independently, with or without support services, whereas 33.3% did so before the programme.

Table III. *Healthcare costs before and after treatment in the Brain Integration Programme*

	Before Mean (SD)	After Mean (SD)	Difference Mean (SD)
General practice, visits/year	0.96 (3.43)	0.75 (1.57)	–0.21
Consulting specialist, visits/year	4.2 (11.0)	2.8 (6.1)	–1.4
Outpatient services, h/year	12 (32)	216 (285)	204*
Extramural care, h/year	80 (222)	40 (97)	–40
Intramural care, h/year	37 (95)	23 (85)	–14

*$p < 0.05$.
SD: standard deviation.

Table IV gives an overview of the costs per patient in Euro the year before and the year after the BIP. As indicated in this table the healthcare costs increased after the programme, whereas the costs of informal care decreased significantly. In addition, the productivity losses (non-significantly) diminished after the programme. As a result the total mean costs per patient significantly reduced ($p < 0.05$). In the year before the BIP the total costs amounted to €48,849, while the costs in the year after the BIP were €39,773. In total there is a decrease in costs of €8676 comparing the two periods.

Sensitivity analyses

The sensitivity analysis showed that the results of our analysis were rather robust. Using tariffs instead of standardized cost-prices for the healthcare costs led to a significant cost difference of €4945 instead of €4685. For informal caring time, the use of the proxy-good method resulted in a significant cost difference before and after the BIP of –€15,383 rather than –€12.000 in our original calculation. The use of the human capital method instead of the friction costs methods revealed a non-significant difference of –€2950 instead of –€1361 for productivity losses.

DISCUSSION

The costs analyses of the BIP showed that the intervention costs of the programme were €68,400 per patient. The analyses

Table IV. *Mean costs, in Euro, per patient before and after treatment in the Brain Integration Programme*

Brain injury related costs	Before	After	Difference
Costs of healthcare professionals			
General practice	19	15	–4
Consulting specialist	105	70	–35
Outpatient services	552	9,936	9,384*
Extramural care	4,000	2,000	–2,000
Intramural care	7,030	4,370	–2,660
Total costs of healthcare professionals	11,706	16,391	4,685*
Medication and aids			
Medication	114	154	40
Memory aids	26	15	–11
Mobility aids	223	185	–38
Home adaptations	7	18	11
Total costs medication and aids	370	372	2
Informal care	24,702	12,702	–12,000*
Productivity losses	11,671	10,308	–1,363
Total costs	48,449	39,773	–8,676*

*$p < 0.05$.

of the costs related to the brain injury showed that there was a reduction in costs after the BIP of €8676 per patient. The sensitivity analyses confirmed the robustness of these results. The reduction in costs may have continued after BIP, as the follow-up period of one year is probably too short to show all community reintegration effects, especially in terms of return to work.

Assuming that the reduction in costs would remain in the next years, and that this reduction in costs could be assigned to the BIP, it can be opted that the sole costs of the programme can be earned back after 8 years. The patients in this study were 30 years had a mean age of when leaving the programme and have another 35 years to go to the age of 65 years (i.e. pensionable age in the Netherlands). Assuming a stable situation in the lives of the patients until the age of 65 years, this means that the profits of BIP stretch out over a period of 27 years, which would plea for the allocation of resources to BIP and, from an economic point of view, favours reimbursement of the costs of BIP by healthcare insurance companies.

Comparing these results with other findings is difficult because of the heterogeneity of the populations, forms of care and economic aspects that have been studied before. The study by Worthington et al. (8) also concerned the cost-analysis of residential rehabilitation programmes for brain injured individuals. They showed that the initial costs of rehabilitation were offset by savings in care costs within two years. This is a shorter period than we found, but the savings were restricted to care costs instead of societal costs. Worthington et al. (8) further found that the projected lifetime savings were higher for those who started rehabilitation within 12 months post-injury than for the medium and longer term admissions. Wood et al. (7) also found greater cost-effectiveness for those who started rehabilitation within two years. These findings suggest that earlier admission to BIP might also lead to greater cost reductions, bearing in mind that the time since injury was rather heterogeneous in our sample.

The cost-analysis we performed has some limitations. First, we studied a rather small group and we did not compare the costs of the patients attending the BIP with a control group of patients not attending the BIP. Part of the cost reduction could have been caused by the natural course of functioning. We expect this effect, however, to be small, since the mean time since injury was more than 5 years. Secondly, data were gathered retrospectively. Patients had to complete questionnaires about costs in the past that could be biased, especially in case of brain injury. This bias was reduced as much as possible by asking both patients and caregivers to complete the questionnaires, on the one hand, and by asking the psychologist to perform a random check of the questionnaires of the patients, on the other hand.

The costs of BIP seem rather high, and therefore it would be interesting to investigate in the future which elements of the comprehensive programme are the most effective. Offering the most effective parts of BIP could reduce the costs of the programme in the future. In this study we looked only at the costs related to brain injury and the BIP and we did not investigate the effects. Therefore this study should be seen as a partial economic evaluation. The effectiveness of the BIP was examined in parallel in a prospective design and reported elsewhere (13, 22). Some of the positive effects in terms of community reintegration can also be found in this study: the number of patients living independently, as well as the level of productivity, increased after attending the programme. We acknowledge the limitations of the present study, but the limited body of evidence on economic aspects of rehabilitation programmes needs to be elaborated further, and this study can be seen as a next step in this direction.

In conclusion, the reduction in societal costs after following the BIP justifies the allocation of resources. These costs should be investigated in the long term and related to the clinical effectiveness of the programme in future research.

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